MARDI Res. Bull. 3, 2: (87 – 93)

PROTEIN SOURCES FOR FEEDING PIGS IN MALAYSIA
I. FISHMEAL

HEW VOON FONG and C. DEVENDRA

Accepted for publication on 22 July, 1975

RINGKASAN

Dua percubaan telah dijalankan untuk mengkaji kesan-kesan aras 'fishmeal' tempatan ke atas perlakuan dan sifat-sifat daging babi. 60 ekor babi kacukan telah digunakan dalam percubaan ini. Matlamatnya ialah bagi menentukan aras 'fishmeal' yang optima untuk makanan babi. Apabila aras fishmeal dinaikkan daripada 0 (control, menggunakan bahan sayur-sayuran) kepada 5, 10, 15 dan 20%, kenaikan berat badan harian bertambah baik, tetapi apabila aras fishmeal dinaikkan lagi hingga 25 dan 27.15%, kenaikan berat badan telah berkurangan. Banyak makanan yang dimakan juga bertambah bila 'fishmeal' dinalkkan dari 0 hingga 20%, tetapi berkurangan bagi aras fishmeal yang lebih dari 20%. Berat badan babi untuk disembelih dicapai paling awal dari makanan yang mengandungi 10 -20% fishmeal. Tidak ada perbezaan dalam sifat-sifat daging di antara babi-babi.

Percubaan bagi menentukan aras fishmeal yang optima dalam jarak 10 hingga 20% menunjukkan tidak ada perbezaan dalam perlakuan babi-babi itu. Walau bagaimanapun aras fishmeal 18% didapati memberi kenaikkan berat badan dan sifat-sifat daging yang paling baik. Perbezaan di antara mutu fishmeal tempatan dan yang diimpotkan ditegaskan. Oleh kerana fishmeal tempatan adalah lebih murah dari yang diimpot, kegunaan 10 hingga 20% fishmeal dalam makanan babi telah dicadangkan.

INTRODUCTION

A programme of research was initiated to assess the quality and level of utilization of individual protein sources necessary to support maximum performance of pigs in Malaysia. It was considered essential to have critical knowledge on the value of all local sources of proteins suited for feeding pigs.

The justification for this assessment lies in the fact that the protein component of the diet of pigs and poultry is the most important single item of cost. It is imperative therefore that its use is judicious and consistent with maximum performance. Furthermore, optimal levels of usage of these products is also justified in the context of economic pig production and the fact that expensive preformed proteins are used most efficiently by the non-ruminants (DEVENDRA, 1975).

Of the animal protein sources useful in efficient pig production, fishmeal is probably the most important and part 1, in this series reports the response of pigs to graded levels of fishmeal. Its usefulness lies in its contribution of crude protein in high quality imported samples of about 57 to 70% and in particular, amino acids such as lysine, ariginine, methionine and cystine and also minerals and vitamins (KIFER *et al.*, 1968). BRAUDE (1961) has reviewed experiments which have shown substantial growth promoting effects when fishmeal was used.

In Malaysia, 1968 saw the growth in local fishmeal production due to a 75% quota imposition on fishmeal imports. The local production was estimated at 14,170 tons constituting 60% of the total consumption of fishmeal in 1971. There are, however, several grades of local fishmeal with protein content ranging from 25%–64.5% (LOW, 1973). On the average, local fishmeal contains about 45% crude protein, 22% ash, 7.6% crude fibre and 1.55% ether extract and 2% salt.

EXPERIMENTAL PROCEDURE

1. Animals

This study included two trials using sixty crossbred pigs of Large White and Landrace strains at 3 months of age. The pigs used in trials 1 and 2 averaged 30.2 and 31.1 kg respectively. In both trial, the pigs were randomly allocated to the different treatments after differences in weight and sex has been taken into consideration. All pigs were individually housed in concrete-floored pens with free access to feeding stall and adequate water supply. Feed consumption and body weight data were recorded weekly.

TABLE 1. COMPOSITION OF EXPERIMENTAL DIETS – TRIAL 1

Ingredients	% Fishmeal						
	0	5	10	15	20	25	27.15
Corn (C.P.–8%)	69.00	69.65	70.00	70.00	70.15	70.65	71.00
Soybean (43%CP)	29.15	23.50	18.15	13.15	8.00	2.50	–
Fishmeal (43%CP)	–	5.00	10.00	15.00	20.00	25.00	27.15
Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Tricalcium phosphate[1]	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Mineral mix[2]	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin[3]	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Antibiotics[4]	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

[1] Tricalcium phosphate special I.C.I.
[2] Biostock (STS). Imperial chemical industries (I.C.I.)
[3] Dohyfral plus premix (Duphar)
[4] Pro-step '60' (M.S.D.)

2. Experiments

In trial 1, 28 pigs were assigned to 7 dietary treatments and in trial 2, 32 pigs were allocated to 8 dietary treatments. The percentage composition of the diets for trials one and two are shown in *Tables 1 and 2* respectively. The crude protein content of the diets were reduced from 18 to 16% when the pigs reached 50 kg live weight. The chemical composition of the ingredients used were analysed for their nutrient content at each mix. In all cases, the analytical techniques used for proximate analyses were those recommended by A.O.A.C. (1965).

The pigs were slaughtered at 80 kg. liveweight. The carcasses were chilled at 3°C for approximately 24 hours. The backfat thickness was calculated as the averaged of measurements taken at the first rib, last rib and last *lumbar vertebra*. Length was measured

from the anterior edge of the 1st rib to the anterior edge of the aitch bone. Plainemeter readings on the cross sectional area of the longissmus muscle were made from tracings taken at the 4th rib for loin eye area measurements.

The results were evaluated by analysis of variance and Duncan's multiple range test as described by STEEL and TORRIE (1960).

TABLE 2. COMPOSITION OF EXPERIMENTAL DIETS – TRIAL 2

Ingredients (%)	% Fishmeal							
	6	8	10	12	14	16	18	20
Corn	69.65	69.75	69.90	70.00	70.15	70.25	70.35	70.50
Soybean	22.50	20.40	18.25	16.15	14.00	11.90	9.80	7.65
Fishmeal	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00
Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Tricalcium phosphate[1]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Mineral mix[2]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin[3]	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Antibiotics[4]	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

[1] Tricalcium phosphate special (I.C.I.)
[2] Biostock (ST5). Imperial chemical Industries (I.C.I.)
[3] Dohyfral plus premix (Duphar)
[4] Pro-step '60' (M.S.D.)

RESULTS

Trial 1.

The results of trial 1 are summarised in *Table 3.*

Table 3 shows that there was a significant ($P<0.01$) response in the average daily gain of the pigs to graded levels of fishmeal. As the level of fishmeal increased, the growth rate also increased until, at 25% fishmeal and above, a depression in growth became obvious. This response in average daily gain to levels of fishmeal is described by the equation $Y = 0.572302 + 0.018952\ x - 0.000829\ x^2$ where Y = average daily gain and x = level of fishmeal.

The inclusion of increasing fishmeal levels resulted in increased feed intake up to 25% after which intake was significantly reduced ($P<0.01$). Thus a quadratic response was evident and is described by the equation $Y = 2.071161 - 0.028159\ x - 0.001186\ x^2$ where Y = feed intake and x = level of fishmeal.

Feeding different levels of fishmeal with differences in the average dialy gain and feed intake resulted in a significant difference ($P<0.05$) in number of days to reach slaughter. Pigs fed 0, 5, 25 and 27.15% fishmeal diets took the longest to reach 80 kg liveweight, whereas pigs fed 10, 15, 20% fishmeal took a much shorter time. Although other carcass parameters did not show any significant difference, it can be seen *(Table 4)* that it is more economical to feed pigs at 10, 15 and 20 percent fishmeal.

TABLE 3. EFFECT OF LEVEL OF FISHMEAL FOR GROWING-FINISHING PIGS (TRIAL 1)

Parameters	Treatment (Fishmeal %)						
	0	5	10	15	20	25	27.15
Avg. daily gain (kg.)	0.61^{ab}	0.63^{abc}	0.71^{a}	0.66^{ab}	0.65^{ab}	0.54^{bc}	0.46^{c}
Avg. daily feed (kg.)	2.10^{de}	2.07^{d}	2.29^{d}	2.24^{d}	2.12^{d}	2.18^{de}	1.88^{e}
Feed/gain	3.60^{fgh}	3.63^{fgh}	3.23^{h}	3.41^{h}	3.24^{gh}	4.14^{fg}	4.15^{f}
No. of days to slaughter	97^{ijk}	102^{ijk}	76^{k}	78^{k}	83^{jk}	107^{ij}	113^{i}
Dressing (%)	79.9	77.3	79.15	80.5	81	76.8	77.6
Backfat, (cm.)	24	23	27	25	24	22	24
Loin area, (cm^2)	15.69	16.41	14.38	16.47	14.88	16.25	16.88

^{abcdf}Rows bearing different superscripts differ significantly ($P<0.01$)

TABLE 4. COST* OF FEED OF PIGS (MALAYSIAN CENTS)

	Treatments (Fishmeal %)						
	0	5	10	15	20	25	27.15
Cost/kg. feed	86.3	84.8	83.7	82.8	81.8	80.2	79.8
Cost/kg. gain	310.7	307.8	270.4	282.4	265.0	332.0	331.2

*Based on tendered price of fishmeal = 131¢/kg, soybean = 148¢/kg, corn 55¢/kg, tricalcium phosphate = 44¢/kg, vitamin 7262¢/kg, biostock = ¢/kg, salt = 44¢/kg, antibiotic = 1452¢/kg.

There is a saving of 46 cents per kg gain in liveweight when 20% fishmeal was used and a saving 14 days between using the 20% and no fishmeal in the diet.

Trial 2

In view of the best response in terms of daily weight gain, food conversion and dressing percentage coming from 10 to 20% fishmeal in the diet, trial two attempted to determine the optimal level of fishmeal inclusion within this range. The results are summarised in *Table 5.*

TABLE 5. SUMMARY OF DATA OF THE PERFORMANCE AND CARCASS CHARACTERISTIC OF PIGS FED DIETS CONTAINING 6–20% FISHMEAL

	6	8	10	12	14	16	18	20
Avg. daily gain (kg.)	0.68	0.74	0.70	0.75	0.71	0.73	0.77	0.71
Avg. daily feed (kg.)	2.21	2.34	2.39	2.34	2.25	2.32	2.39	2.44
Feed/gain	3.55	3.19	3.39	3.50	3.41	3.21	3.12	3.43
No. of days to slaughter	75	75	72	70	75	72	68	72
% Backfat	2.54	2.29	2.65	2.17	2.29	2.10	2.98	2.40
Dressing (%)	75.50	74.40	77.65	76.25	76.65	74.35	76.35	74.50
Loin area, (cm^2)	13.60	15.50	16.00	18.50	16.68	18.00	17.00	15.70

Table 5 shows that there were no differences in performance and carcass characteristic of pigs fed different fishmeal levels. However, the 18% level of fishmeal gave the best results in terms of average daily gain, average daily feed, feed efficiency as well as the carcass measurement.

DISCUSSION

The inclusion of increasing level of fishmeal in the pig's diets brought about a corresponding improvement in average daily gain up to a level of 20% above which a significant depression in body weight gain was observed. Moderate levels of fishmeal appear to exert some growth promoting effect, and encouraged a greater growth response in pigs in comparison with the all-vegetable control diet. LAKSERVELA (1961) found that most of the response in growth and feed efficiency was obtained at levels of 6–8% whereas with local fishmeal, better response was seen at levels of 10 to 20%, the optimum being nearer 20%. This difference may be explained by the quality of the fishmeal. Local fishmeal is inferior in protein quality to the imported fishmeal and requires a higher addition of other protein to bring about a better amino acid balance. Also the local fishmeal is higher in ash (22% compared to 16% for Peruvian fishmeal,) and this may be factor causing a depression in growth when more than 20% fishmeal was used.

In trial one, significant differences ($P<0.05$) were found in daily liveweight gain between soyabean or fishmeal as the only source of protein in favour of soyabean. This is unexpected and may well reflect poor quality fishmeal since fishmeal has been reported to be better than soyabean meal (FREM and UBBELS, 1951) or comparable in performance to it (KIRSCH, 1959; KIRSCH and FENDER, 1960; RABOLD and SELVEN, 1960).

Fishmeal in general is known to contain higher levels of vitamin B_{12} and is also rich in zinc (OUREN, 1957) and also selenium (GRIFFO and MOXON, 1973). These factors may have contributed to the overall improvement in growth rate of pigs.

It is interesting to note that feed intake was reduced significantly when fishmeal levels of 25 and 27.15% were used. Palatability may be a factor affecting this. The strong smell of fishmeal and the scaly nature and therefore the ash content may be factors reducing intake. It was also calculated that it is uneconomical to add such high fishmeal levels, and the most economical level appears to be 20%. The important point is that local fishmeal which is cheaper than either imported fishmeal or soyabean meal can be economically incorporated in the diet of pigs at levels between 10–20%.

Within the range of 6 to 20% fishmeal level in pig's diet, no difference in performance was obvious, although the 18% fishmeal diet gave consistently better response in all the parameters taken. In terms of meat quality and meat palatability, LAKSESVELA (1961) reported significant reduction in palatability, and softer fats at such levels. This has yet to be determined although subjective tasting by 6 members of the staff did not indicate any differences.

ACKNOWLEDGEMENTS

The authors wish to thank Mr. Low Wan Loy for his assistance in statistical analysis. Special thanks are due to S. Nantha Kumaran, K. Balasubramaniam and S. Poovan for their part in this project.

SUMMARY

Two trials involving 60 cross-bred pigs were conducted to study the effects of different local fishmeal levels on performance and carcass characteristics of growing-finishing pigs. The objective was to determine the optimal economic level of fishmeal inclusion. Increasing the fishmeal from 0 (all-vegetable based control) to 5, 10, 15 and 20% in the diet increased the daily liveweight gain of the pigs, but further increases of fishmeal levels 25 and 27.15% depressed growth rate. Feed intake followed the same trend with intake increasing from 0 to 20% fishmeal, but decreasing with levels higher than 20%. The number of days taken for the pigs to reach slaughter weight was least for levels at 10 to 20% fishmeal. However, no differences in carcass characteristics was observed for all pigs.

An attempt to identify the optimal level of local fishmeal inclusion within the range of 10 to 20% gave no differences in overall performance. However, the 18% level of fishmeal appears to be optimal as it gave the best growth rate as well as carcass characteristics. Differences in the quality of imported and local fishmeal are also stressed. The use of local fishmeal at levels of 10% to 20% is recommended because local fishmeal is cheaper than the imported one.

REFERENCES

Association of Official Agricultural Chemists (1965). Official Methods of Analysis. Tenth Ed., Washington.

BRAUDE, R. (1961). FAO International Conference on Fish in Nutrition, Washington D.C., U.S.A.

DEVENDRA, C. (1975). Efficient utilisation of feedingstuffs in Malaysia: perspectives and potential prospects. Proc. Malays. Soc. Anim. Prod. Seminar on *Livestock Production and the Food Crisis*, 4th Jan. 1975, p. 18–32.

FREMS, A.M. and UBBELS, P. (1951). Versl. Lamdbonwk. Onderseek, No. 57, cited by R. Braude, 1961.

GRIFFO, A.P. and MOXON, A.L. (1973). Fishmeal as a source of selenium in sows. *J. Anim. Sci. 37* : 280 (Abstr.).

KIFER, R.R., POYRE, L.L., MILLER, D. and AMBROSE, M.E. (1968). *Feedstuffs.* 40 : 36.

KIRSCH, W. and FENDER, M. (1960). Versuche uber den Ersatz Von Fishmeal durch soga – Extraktions – schrote be, der getreideschnellmast von Schweinen. *Ztschr. Tierphysiol. Tierernahrung Futtermitleck. 15* : 257–265.

KIRSCH, W. (1959). Cited by Braude, 1961. *Futter u. Futterung, 10* : 96.

LAKSESVELA, B. (1961). Graded levels of herring meal to bacon pigs effect on growth rate, feed efficiency and bacon quality. *J. Agric. Sci. Comb. 56* : 307–315.

OUREN, I. (1957). Universitetot i Bergen. Arbok 1957. *Marurvitenskapelig rekko. No. 9.*

RABOLD, K. and SELVEN, P. (1960). Cited by Braude, R. 1961. Arheiten der handwirstschaftl chen Hochsume Hohenheim., 1:45.